Nov 30th, 12:00 AM

Management of Bean Leaf Beetles and Bean Pod Mottle Virus: A Summary of Current and Future Research

Rayda K. Krell
Iowa State University

Jeffrey D. Bradshaw
Iowa State University

Marlin E. Rice
Iowa State University, merice@iastate.edu

John H. Hill
Iowa State University, johnhill@iastate.edu

Larry P. Pedigo
Iowa State University

See next page for additional authors

Presenter Information

Rayda K. Krell, Jeffrey D. Bradshaw, Marlin E. Rice, John H. Hill, Larry P. Pedigo, and Mark E. Westgate

MANAGEMENT OF BEAN LEAF BEETLES AND BEAN POD MOTTLE VIRUS: A SUMMARY OF CURRENT AND FUTURE RESEARCH.

Rayda K. Krell[1]
Graduate Research Assistant

Jeffrey D. Bradshaw[1]
Graduate Research Assistant

Marlin E. Rice[1]
Professor

John H. Hill[2]
Professor

Larry P. Pedigo[1]
Emeritus Professor

Mark E. Westgate[3]
Professor

[1]Department of Entomology, Iowa State University
[2]Department of Plant Pathology, Iowa State University
[3]Department of Agronomy, Iowa State University

In 2002, the bean leaf beetle, *Cerotoma trifurcata* (Forster), population reached the highest level recorded in 14 years (Fig. 1). The bean leaf beetle is now considered the most frequent insect pest of Iowa soybean, and concern over this pest is greater because it transmits a soybean virus, *Bean pod mottle virus* (BPMV). Bean leaf beetle management recently has become more complicated because of this insect's association with BPMV, therefore, it is important to understand the life cycle of the beetle and its relation to BPMV before management decisions are made.

Bean Leaf Beetle Biology

The bean leaf beetle has two generations in Iowa. Beetles overwinter as adults in wooded areas in plant debris. In late May, beetles emerge from overwintering habitats and begin feeding on legumes, such as alfalfa. As soon as soybeans emerge, beetles move to soybean to feed. In June, the overwintered beetles mate and females lay eggs in the soil near soybean plants. First-generation beetles reach peak levels in mid to late July. Second-generation beetle densities peak in late August or early September. Beetles stay in soybean fields until plants senesce and then move to legumes to feed, later entering overwintering sites as the temperature cools.

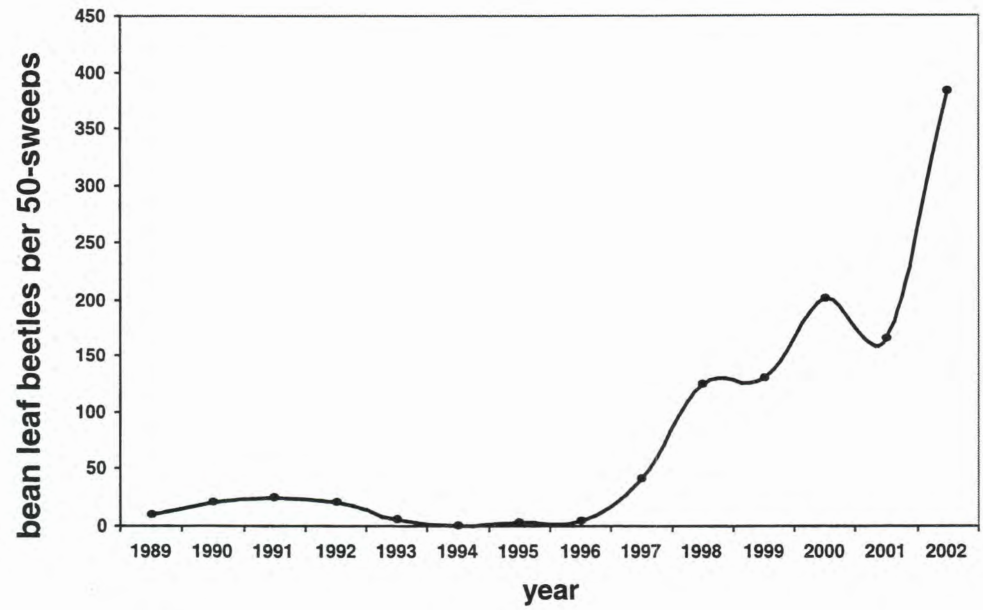


Fig. 1. Second-generation bean leaf beetle population trend from 1989-2002 at Iowa State University Johnson Farm, Ames, IA.

Overwintered, first and second generation beetles feed on soybean foliage, but second-generation beetles also feed on soybean pod tissue. Beetle injury to pods can result in direct yield loss when pods are fed on or clipped from soybean plants. Additionally, pod feeding results in reduced soybean quality because pod feeding allows entrance of fungi into pods and can cause the beans to desiccate.

Bean Pod Mottle Virus and the Disease Cycle

Bean pod mottle virus has been shown to cause yield reductions over 50% (Hopkins and Mueller 1984) and seed coat mottling (Lin and Hill 1983). The symptoms of BPMV include a blistered appearance to soybean leaves and mottled seed coats. The effects of BPMV can be even greater when the virus occurs with another soybean virus, soybean mosaic virus (SMV) (Calvert and Ghabrial 1983). Additionally, BPMV has been associated with increased incidence of green stem (Schwenk and Nickell 1980) and Phomopsis seed decay (Abney and Ploper 1994).

Recently, research at Iowa State University showed that BPMV can originate from three sources: 1) soybean seed, 2) overwintered bean leaf beetles, and 3) in an alternate host, showy tick trefoil, *Desmodium canadense*. It is important to note that all three sources occurred at very low levels. Seed transmission of BPMV occurred at 0.037% and only in one variety of two that were tested. Only one in 66 overwintered bean leaf beetles transmitted BPMV to a soybean seedling, and only one tick trefoil plant out of five collected from the field was positive for BPMV. Although, these BPMV sources may be occurring at low levels, combined with the high bean leaf beetle population, these sources probably provide enough inoculum to account for high BPMV field incidence.

Management

The latest agronomic soybean management recommendations have encouraged early soybean planting. While early planting has been shown to increase yield and is often more convenient for growers, it can also encourage high bean leaf beetle populations and high BPMV incidence. When female beetles feed on soybean they lay more eggs and live longer than when reared on other legumes. It is suspected that increased adoption of early planted soybeans and mild winters in the recent years have contributed to the high bean leaf beetle populations, and increased incidence of BPMV.

Bean Leaf Beetle Management Only (no BPMV)

Bean leaf beetle monitoring is the foundation of a management program for this pest. Beetles can be sampled using a ground cloth or a sweep net. Monitoring first generation beetles may help to make predictions about second-generation beetle density, which tends to be the most damaging generation. Monitoring second generation beetles may aid in estimating risk of high populations in the next season. When economic thresholds for bean leaf beetle are exceeded insecticide application is recommended. Delaying soybean planting until after peak overwintered bean leaf beetle emergence (usually mid-May) is a good idea (Pedigo and Zeiss 1996) if a field has a history of bean leaf beetle problems.

Bean Leaf Beetle and Bean Pod Mottle Virus Management

Research at Iowa State University in 2000-2002 has been underway to develop BPMV management options. Currently, there is no known resistance to BPMV in any commercially available soybean variety, therefore, current management options focus on suppression of the vector, the bean leaf beetle.

An experiment compared three insecticide management tactics at two field sites in central and northwest Iowa. At each location a different soybean variety was planted. At the central site a food-grade variety was used and at the northwest site a production-grade variety was planted. The insecticide chosen for the study was Warrior (lambda-cyhalothrin, Syngenta, Wilmington, DE) because Hammond (1996) reported that it provided residual suppression of the bean leaf beetle. The three insecticide tactics tested were: 1) one early season spray at soybean emergence (2.5 oz./acre), 2) two early season sprays, one at soybean emergence and one approximately 10 days later (both at 2.5 oz./acre), and 3) one early season spray at soybean emergence (2.5 oz./acre) followed by a mid season spray (3.2 oz./acre) when first-generation bean leaf beetles were found in the field. All insecticide treatments were compared to an unsprayed control.

The management tactic applying an insecticide once early and once at mid-season suppressed bean leaf beetle populations, reduced BPMV incidence (Fig. 2), and protected seed quality (Fig. 3) and yield (Fig. 4). Therefore, this tactic is a tested management option for soybean growers concerned about BPMV.

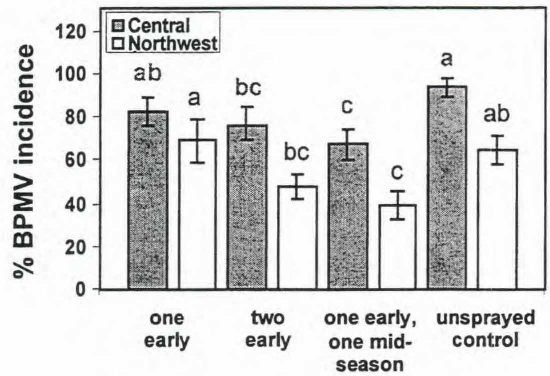


Fig. 2. Percentage BPMV incidence by treatment.

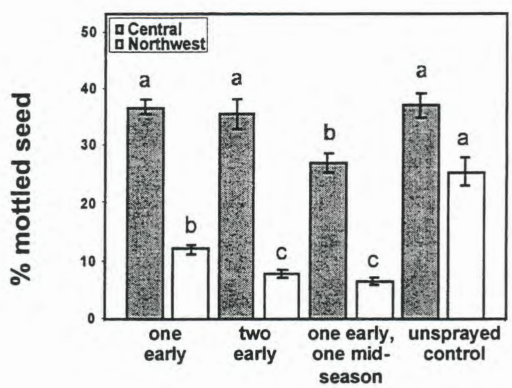


Fig. 3. Seed mottling by treatment.

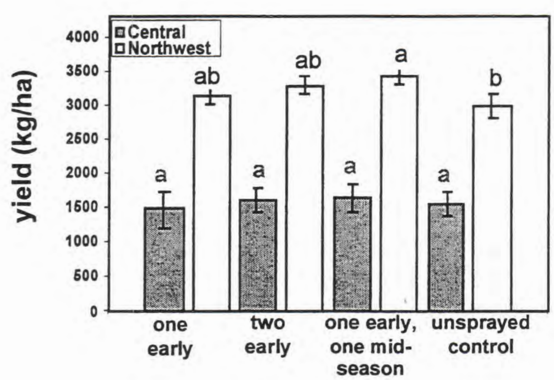


Fig. 4. Soybean yield by treatment.

Additionally, the Departments of Entomology and Plant Pathology, joined with the Department of Agronomy to examine the relationship between soybean planting date and BPMV and whether planting date could be manipulated for BPMV management. There were no consistent results from all three years, but there was some evidence that delaying planting could help to reduce BPMV incidence (Fig. 5), and protect yield (Fig. 6).

Planting date studies will likely continue, and it is possible that treatment effects were masked because the plot sizes were small and beetles moved between plots.

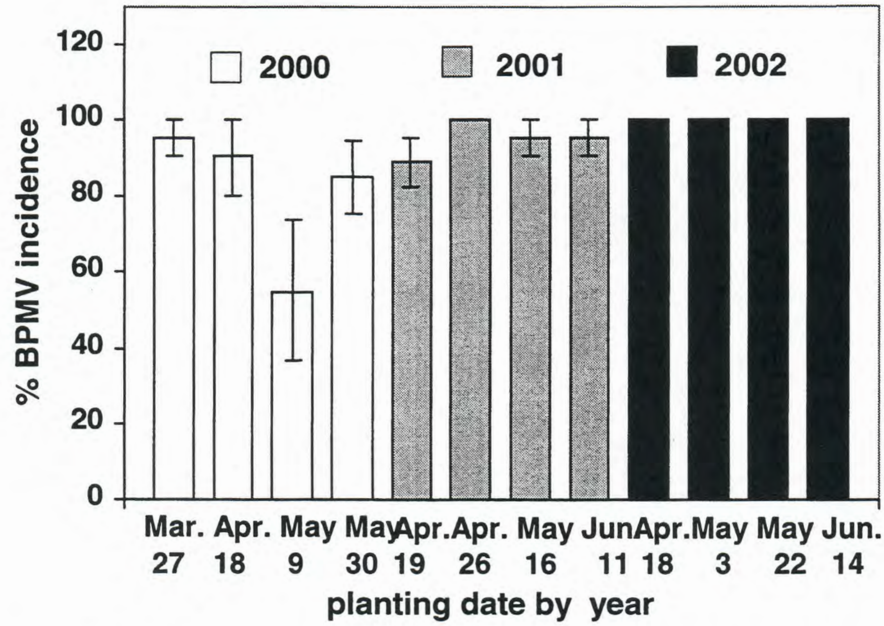


Fig. 5 Percentage BPMV incidence by soybean planting date and year.

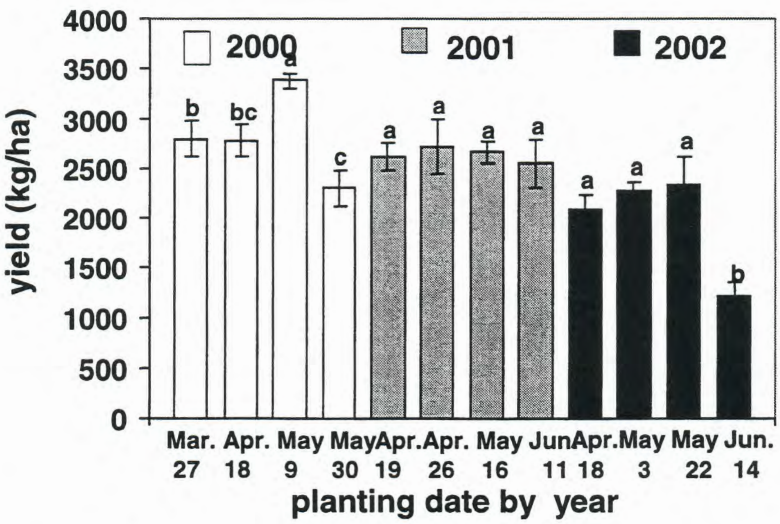


Fig. 6. Yield by planting soybean planting date and year.

Continuing Research

Long-term, a more convenient early-season management option for bean leaf beetle and BPMV is needed. Although not yet registered for soybean, systemic seed-treated insecticides offer a potential tool for the management of this pest complex. Seed-treated insecticides have a reduced environmental impact, reduced soil compaction, are more convenient for the grower, and protect soybean from insect injury at emergence.

Thiamethoxam and clothianidin are two experimental systemic, neonicotinoid compounds. Thiamethoxam significantly reduces bean leaf beetle abundance (M. E. Rice, unpublished data) relative to untreated soybean plots. Clothianidin has not yet been tested against bean leaf beetles.

Seven treatments were chosen: 1) thiamethoxam (0.3g/kg), 2) clothianidin (16 fl.oz./cwt), 3) early season lambda-cyhalothrin (1.92 fl.oz./acre), 4) mid-season lambda-cyhalothrin (3.5 fl.oz./acre), 5) thiamethoxam (0.3g/kg) + mid-season lambda-cyhalothrin (3.5 fl.oz./acre), and 6) early and mid-season lambda-cyhalothrin (1.92 fl.oz./acre and 3.5 fl.oz./acre, respectively).

The experiment was conducted at three locations: central, northeast, and northwest Iowa. Bean leaf beetles were sampled weekly. BPMV incidence was determined by collecting leaves in each treatment after the decline of the 1st-generation bean leaf beetle population. Bean pod mottle virus-incidence was detected using an enzyme-linked immunoabsorbent assay.

Insecticide treatments significantly suppressed vector numbers at key times during the growing season, i.e., at emergence of overwintered and first-generation bean leaf beetle populations at the Northwest Iowa Research Farm (Table 1). Lack of significance during sample dates 6/12-7/3 likely is due to low bean leaf beetle abundance (i.e., these dates are between the overwintered and first-generation bean leaf beetle populations).

Table 1. Mean[1] bean leaf beetles collected from insecticide-treated and an untreated soybean plots for twelve sample dates (Northwest Iowa Research Farm).

	5/20	5/29[2]	6/5	6/12	6/18	6/26	7/3[3]	7/12	7/17	7/23	7/31	9/25
C	0.75a	18.25a	6.5a	2.5a	0.25a	0.25a	1.0a	16.0a	20.25a	16.0ab	4.5a	67ab
Th	0.25a	2.5c	1.5c	0.25b	0.25a	0a	0a	2.75b	16.5a	12.25abc	2bc	79.5a
Cl	0.25a	7.25b	4.25b	1.0ab	0.75a	0.25a	0a	4.75b	17a	18a	3.75ab	67.25ab
E-L	0a	3.75bc	0.25c	1.5ab	0a	0a	0.25a	6.0b	14.5ab	19.5a	1.75bc	65.5ab
M-L	0.25a	17.5a	5.25ab	1.5ab	0.75a	0.25a	0.75a	0b	4.5c	3.5c	3.75ab	59.5ab
Th + M-L	0a	3.75cb	1.0c	0.75b	0.75a	0a	0a	0.25b	5.75bc	7.25bc	1.5c	48b
E-L + M-L	1.5a	2.5c	0.75c	0.25b	0.25a	0a	0.5a	0.25b	2.5c	2c	5a	50.25b
P-value	*0.4859*	*<0.0001*	*<0.0001*	*0.1073*	*0.5791*	*0.6589*	*0.5213*	*0.0246*	*0.0042*	*0.0117*	*0.0088*	*0.157*

Legend: C=unsprayed control, Th=thiamethoxam, Cl=clothianidin, E-L=early season lambda-cyhalothrin, M-L=mid-season lambda-cyhalothrin.

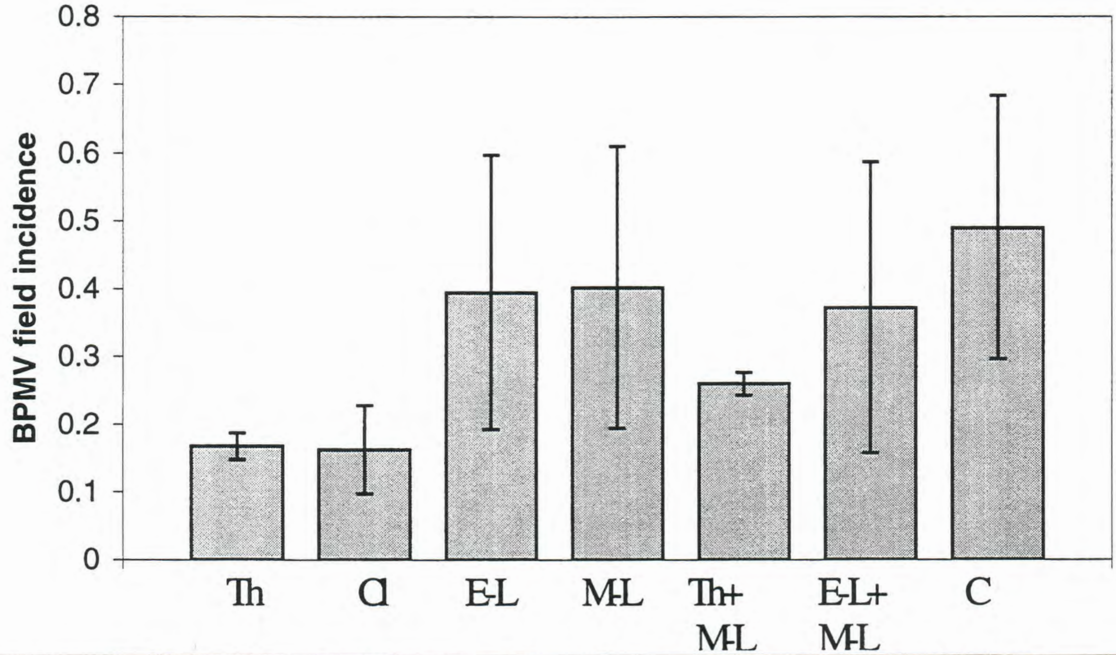
[1] Treatment means followed by similar letters are not significantly different at α=0.05.

[2] Early season lambda-cyhalothrin treatments applied just prior to this date.

[3] Mid-season lambda-cyhalothrin treatments applied just prior to this date.

Late-season BPMV incidence was not significantly different between treatments (Fig. 7). However, seed treatments did tend to reduce the percentage of BPMV infection within plots relative to the control.

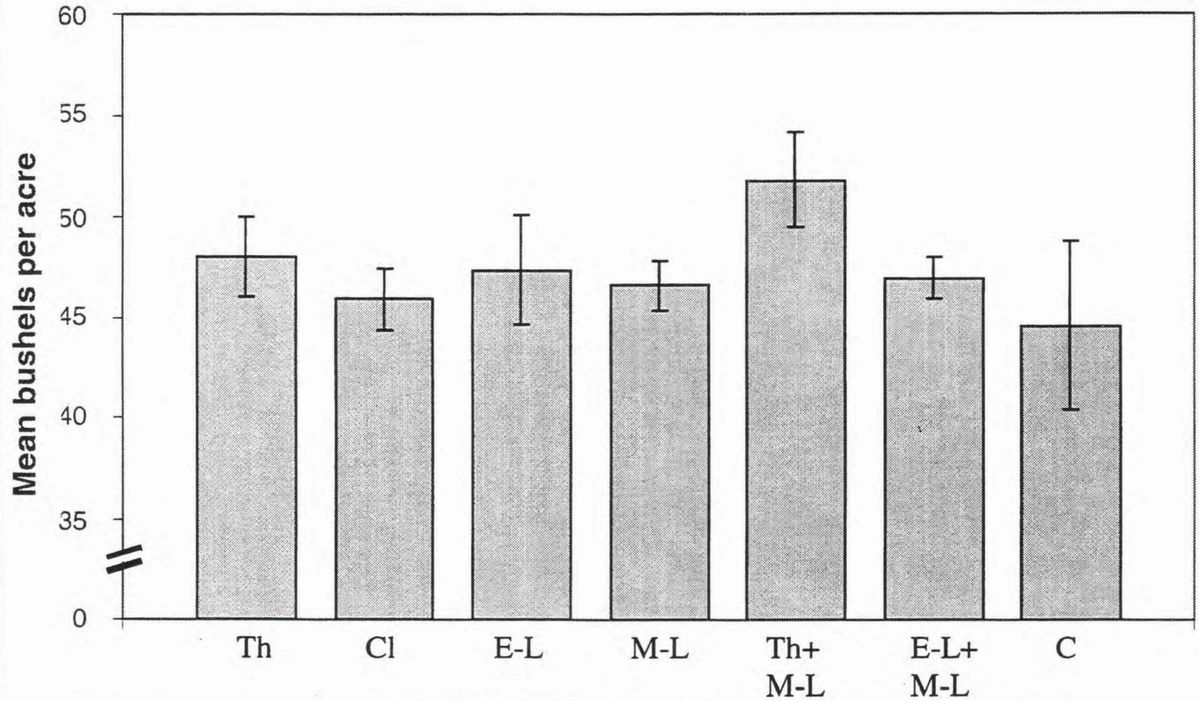
Fig. 7. Bean pod mottle virus field-incidence in insecticide treated and an untreated plots (Northwest Iowa Research Farm).



Legend: Th=thiamethoxam, Cl=clothianidin, E-L=early season lambda-cyhalothrin, M-L=mid-season lambda-cyhalothrin, C=unsprayed control.

Plot yields were not significantly different from the untreated control; however, the treatment with thiamethoxam plus mid-season lambda-cyhalothrin had the highest mean yield of all the treatments (Fig. 8).

Fig. 8. Yield of insecticide-treated and an untreated soybean plots (Northwest Iowa Research Farm).



Legend: Th=thiamethoxam, Cl=clothianidin, E-L=early season lambda-cyhalothrin, M-L=mid-season lambda-cyhalothrin, C=unsprayed control.

Seed treatments suppressed vectors early season. A mid-season, foliar application of lambda-cyhalothrin significantly suppressed vectors in seed-treated soybean; therefore, seed treatments have the potential to decrease BPMV incidence.

Lack of significant differences between treatments for yield and BPMV incidence may be because plot sizes were relatively small (30 ft by 100 ft). In smaller plots vectors can easily r move between plots, thereby increasing error. Plans are under way to increase plot sizes for next year's study.

Future research plans are to continue to monitor bean leaf beetle populations, continue management studies, and to study aspects of bean leaf beetle behavior within this pest complex.

References

Abney, T. S. and L. D. Ploper. 1994. Effects of bean pod mottle virus on soybean seed maturation and seedborne *Phomopsis* spp. Plant Dis. 78:33–37.

Calvert, L. A. and S. A. Ghabrial. 1983. Enhancement by soybean mosaic virus of bean pod mottle virus titer in doubly infected soybean. Phytopathology 73:992–997.

Hammond, R. B. 1996. Residual activity of lambda-cyhalothrin against bean leaf beetle (Coleoptera: Chrysomelidae) in soybeans. J. Agric. Entomol. 13: 365–373.

Hopkins, J. D. and A. J. Mueller. 1984. Effect of bean pod mottle virus on soybean yield. J. Econ. Entomol. 77:943–947.

Lin, M. T. and J. H. Hill. 1983. Bean pod mottle virus: occurrence in Nebraska and seed transmission in soybeans. Plant Dis. 67:230–233.

Pedigo, L. P. and M. R. Zeiss. 1996. Effect of soybean planting date on bean leaf beetle (Coleoptera: Chrysomelidae) abundance and pod injury. J. Econ. Entomol. 89:183–188.

Schwenk, F. W. and C. D. Nickell. 1980. Soybean green stem caused by bean pod mottle virus. Plant Dis. 64:863–865.